



Original Article

Comparison of Fat Graft in Post-Burn Scars versus Platelet-Rich Plasma Regarding Scar Quality and Healing

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ABSTRACT

Post-burn scars occur when burns damage the skin leading inevitable injury. Various techniques are applied for treatments and reduction so f these scares. **Objective:** To compare the effect of Platelet Rich Plasma (PRP) and fat graft in post-burn scars on the outcome of the healing process and quality of chronic wounds. **Methods:** One hundred cases were equally divided in group I (platelet-rich plasma) and group II (fat graft), age between 20-60 years were enrolled. The patients were those who were having post traumatic or and post burn chronic wounds which were within the duration of ≥ 3 months. A 5cc blood was withdrawn from each patient. Fat graft and platelet rich plasma were prepared, applied and compared for up to 12 weeks for their wound size, healing rate and scar quality. **Results:** There was no difference win age or gender within groups with a mean age of 43.46 and 44.36 years in group I and Group I. The comparative analysis within the original wound size and decrease in it within the 4 weeks' time followed by 12 weeks' time presented significant variance with both procedures bringing sufficient minimizing in the size, however a slight better result was presented in group II in comparison with Group I. Average healing rate was higher in group II than group I. **Conclusions:** Both procedures are efficient in terms of scar quality and healing of post burn scar. However, within the two groups the fat graft is more efficient and reliable with high healing time and rate.

INTRODUCTION

Post Burn Scars (PBS) are unavoidable, inevitable depending upon the how deep is the burn injury. Fat grafting is a common and popular procedure within plastic and cosmetic surgery involving reconstruction of soft tissue as well as augmentation, within the various advantages related with this procedure are accessibility, versatility and non0immunogenicity [1, 2]. There have been abundant literatures highlighting the application fat grafting for contouring tissue defects, scar-softening and improvements in fibrosis [3-6]. Although there are various benefits related with fat graft however, yet the major challenge is the survival rate prediction [7]. There have

been evident reports on long term resorption of graft in many patients with hypoxia and Reactive Oxygen Species (ROS) formation leading to fat necrosis and graft loss [8, 9]. The passive diffusion as well as perfusion of the surrounding tissue are the main source of nutrition for the grafted fat yet adequate neo-vascularization is considered equally significant for the survival of the graft [10, 11, 12]. With the advancement of technology various other procedures have been introduced which can control and increase the survivals rate of the graft. These procedures include Platelet Rich Plasma (PRP), Platelet Rich Fibrin (PRF), and stromal vascular fraction. These procedures can

be opted alone or in combination with fat graft for improved result an enhance neo-vascularization [13]. Platelet-rich plasma is an autologous concentrated platelets source, for the development and regeneration of cytokines and growth factors [14-20]. There have been several studies for identifying the role and significance of PRP, however a mutual consensus is still lacking in predicting its precise significance due to lack of authentic literature [21].

The current research was designed for specifically identifying the role of fat graft in comparison with the PRP in terms of scar quality and healing in post burn patient's care. The results of this study have highlighted the prominent advantages of both the procedures with also emphasizing on comparative details which can elaborate the more appropriate procedure among the two providing better health outcomes.

METHODS

This comparative prospective study was conducted in the Department of Plastic Surgery, Lahore General Hospital, Lahore 1st January 2023 to 30th June 2023 with Institutional Review Board (IRB) Approval Number: 117-22 dated: 24th November, 2022. A total of 100 cases were selected after calculating the sample size through available sample size calculator on WHO sample calculator site. The power of test was taken as 80% while CI as 95% with 5% margin of error for calculation of sample size. The patients were divided into two groups where each group was having 50 cases in them. The group I were those patients who were given PRP treatment for burns while in group II those patients who opted fat graft as a post burn treatment were placed. Each patient was enrolled as a study participant was presented with the informed consent for signatures and concurrence. After their permission of each patient they were considered as study participants. The age of the patients was between 20-60 years. The patients were those who were having post traumatic or and post burn chronic wounds which were within the duration of ≥ 3 months. Those patients who were having acute wounds or any autoimmune disorder or were on anticoagulant treatment, suffering from diabetes, hepatic disorders, renal failure or pregnant were excluded from the study. Chronic wounds as a consequence of malignancy were also excluded from the study. All chronic wounds were debrided initially for the removal of the necrotic tissue and for the preparedness of the wound bed. All demographic and clinical details were entered in a well-structured questionnaire. The evaluation of each wound was properly conducted before any treatment procedure. Clinically clean wound was assessed through the case definition wherein it had a clean bed with tissue granulation pinkish to red in color, soft, painless and having no necrotic discharge or odor. In unhealthy tissue initially, the culture sensitivity

was performed and bacterial count assessed. In cases of 10 org/gm tissue the patients were considered as excluded. A 5cc blood was withdrawn from each patient. In group I the blood was centrifuged at 3000 rpm for 3 min with the acellular plasma as the top most layer comprising of 40% of the acellular plasma is termed as Platelet Poor Plasma (PPP). This layer is followed by the "buffy coat" middle layer made of 5% of the total volume. Whereas the last layer comprising 55% of the total acellular plasma is made of red blood cells layer. When the primary centrifugation is complete then the topmost layer is removed through sterile-syringe and middle layer is transferred in another sterile tube wherein extra care is taken in not including the bottom red blood cells with the middle layer. The bovine thrombin is than mixed in the middle layer (PRP) with a PRP ratio of 1cc per 0.2 ml and 0.1ml calcium chloride. Within the group II lower abdomen liposuction was performed under general anesthesia and the collected fat was emulsified through mechanical force and used for fat graft. The fat graft harvesting was done through blunt tip cannula which was 3mm dm and connected with the 10cc Leurlok syringe. The isolated 3 layers post 3000 rpm centrifugation consisted of top oily layer, middle fat graft while lower as fluid layer for decant. The middle layer was again emulsified mechanically between 1mm leurlok syringes approx. up to 30 times. PRP or fat graft were applied on wound area through 2 ml per cm², which was further followed by the Vaseline gauze application and dressing. Within the Group I the preparation was freshly done as twice per week. The amount of fat prepared is only once in Group II and was around 500-600cc with 50cc stored amounts at -20°C. The amount of fat applied depended upon the chronic wound. Each fat sample was thawed at room temperature 15 minutes prior application. Wound surface region was calculated through the measurements of the wound width as well as wound length. Then the healing rate of the wound was calculated. All dimensions were measured using metric tape at the first visit and then every week. The healing rate was calculated as follows: $\text{Original wound area (cm}^2\text{)} - \text{remaining wound area (cm}^2\text{)} \times 100 / \text{original wound area [21]}$. Images were taken before and after the initiation of the treatment and during the follow up visits on the 4th week and on the 12th week of initiation of the post treatment method. Histopathological assessment of the healing in both groups was performed by applying a punch biopsy that has been taken from the wound including the edge and the bed on the 1st visit and the 4th week in both groups to be compared. The other assessment regarding peri-lesions skin quality such as pliability, the depth of wound and erythema were also evaluated. The approach used to examine wound healing histology involved creating a cutaneous wound of specific depth and size and consequently monitoring its size over time [22]. The rate of

re-epithelisation was often calculated in these studies. The histological data obtained in all of these experiments were the secondary outcome to the clinical endpoint of the wound healing or the flap/graft surviving. The pain evaluation was performed through patient questioning using Visual Analogue Scale (VAS) scoring method which ranged from 0-10 wherein 0 indicated no pain while 10 meant worst pain. Histopathological assessment at 4th week through edge and in-depth wound punch biopsy was also conducted in both groups. Data were statistically analyzed using SPSS version 25.0. T test and Chi square was applied for comparing groups. p Value of <0.05 was taken as significant.

RESULTS

There was no difference in age or gender within groups with a mean age of 43.46 and 44.36 years in group I and group II. Males prevalence was higher in both groups. The etiology explained the presence of full thickness burn in 60% group I and 52% group II cases (Table 1).

Table 1: Comparison of Age, Gender and Etiology in Both Groups (n=100)

Variables	Group I (n=50) (Mean ± S.D)	Group II (n=50) (Mean ± S.D)	p-Value
Age (Years)	43.46 ± 11.5	44.36 ± 10.5	0.81
Gender (%)			
Male	66%	60%	0.77
Female	34%	40%	
Etiology (%)			
2 nd Layer Deep	40%	48%	0.85
Full Thickness	60%	52%	

The duration of the wound varied within both groups with varied regions been involved. The comparative analysis within the original wound size and decrease in it within the 4 weeks' time followed by 12 weeks' time presented significant variance with both procedures bringing sufficient minimizing in the size, however a slight better result was presented in group II in comparison with Group I (Table 2).

Table 2: Comparison within Reduction in Wound Size/Scar Quality within Group I and Group II

Wound Site	Wound Duration (Months)		Original Wound Size (cm ²)		Wound Size After 4 Weeks (cm ²)		Wound Size After 12 Weeks (cm ²)		p-Value
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	
Right Forearm	5	6	14	11	8	7	5	4	0.032
Left Forearm	6	3	24	14	15	7	8	4	0.021
Right Leg	7	3	20	26	11	12	10	9	0.031
Left Leg	4	6	15	22	9	13	7	7	0.025
Right Arm	6	8	15	17	8	11	6	7	0.026

Left Arm	3	7	16	16	12	10	8	5	0.049
Right Hand	4	4	18	20	12	14	4	5	0.041
Right Knee	3	3	22	20	16	15	10	9	0.040
Right Foot	5	3	18	16	14	12	10	8	0.039

The healing time was also compared within both groups and it was interpreted through data that average healing rate was higher in group II than group I. In addition to this the healing rate was also significantly higher in the group II patients than group I patients (Table 3).

Table 3: Comparison of Healing Area per Day and Healing Time within Group I and Group II

Variables	Group I (PRP)	Group II (Fat Grafts)	p-Value
Wound Area (Mean ± S.D)	16 ± 3.8	19 ± 3.7	<0.05
Avg. Healing Area/Day (cm ²)	0.20	0.23	
Healing Rate (%)	56%	65%	

The histopathological slides presented more efficient healing in group II when compared with the group I at 4th week as is illustrated through figure 1. Efficient healing of group I; A-at first visit with several inflammatory cells-infiltrate the deep dermal layers (as revealed through the dotted line). B-at 4th week in Group I with a decrease in inflammatory cells subsequently post application of PRP. In group II; A-at first visit with several inflammatory cells-infiltrate the deep dermal layers (as revealed through the dotted line). C at the 4th week in Group II with a marked decrease in the inflammatory cells after application of emulsified fat. Resolution W/H: 518/554 Pixels Punch biopsy from the wound edge and bed in the 1st visit and in the 4th week after application of PRP (Group I) and after application of emulsified fat graft (Group II) was performed. The histopathological evaluation of the received specimens presented a reduction in the lymphocytic-infiltration within deep dermal layers, below the dotted line as present in Fig 1 of group I and group II. However, a significant reduction was observed in group II when compared with group I. This indicated reduction in the lymphocyte-mediated chronic inflammatory response within both groups with more efficient result in group II at 4th week. Further reduction in the discharge, erythema as well as improvement in perilesional-skin quality with raised pliability were the salient features observed. Erythema was determined through the first 6-8 weeks of healing, then it started to decline by the 10th week till complete healing when it was very minimal but did not disappear completely. Skin pliability started to improve gradually, with yielding from the 5th week till the 10th week while further it became supple from the 10th week till complete healing attained. In the present study the in-depth wound thickness was improved, it was decreased gradually from the beginning of

the study till complete healing. Relating to VAS score in current study, it was initiated with a score of 6 in the 1st week, score of 4 in the 2nd week and a score of 2 in the 3rd week to the 7th week, then score 1 till complete healing in Group I. Whereas in Group II, it was started with a score of 6 in the 1st week, score of 3 in the 2nd week to the 6th week and a score of 1 in the 7th week to till complete healing.

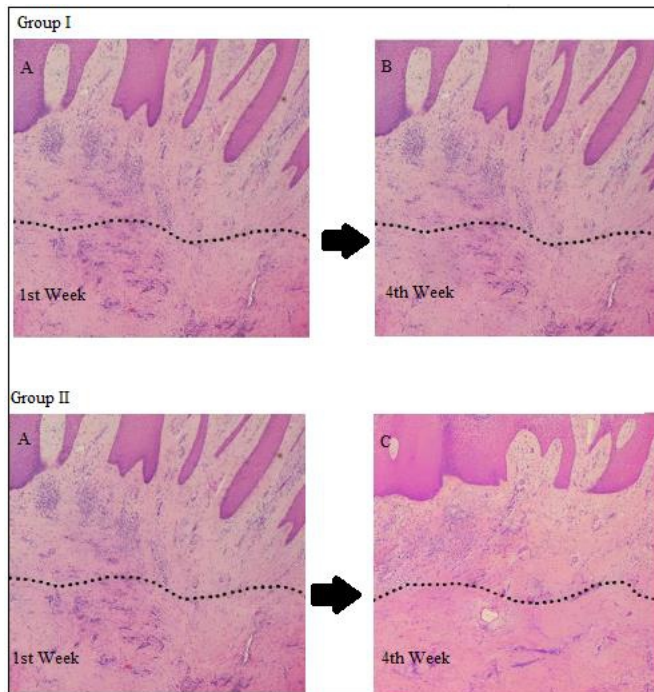


Figure 1: Comparative Histopathological Slides of Group I and II

DISCUSSION

The chronic wounds are a major challenge experienced by a surgeon. These wounds not only cause cost but have a high degree of morbidity related with them. A major identified cause of these wounds is the lack of growth hormone release. Traditional modalities do not apply the formation of the growth hormone resulting in the poor healing of the wounds. Within the late 80s the first PRP technique containing growth factors was used for healing of ulcerations. However, its use in post burn scars is still under establishment [18-20]. Majority of the cases which approach a hospital setting with post burn scars are male which get these scars through road traffic accidents. However, it is pertinent to note that the number of females having post burn scar is also not less evident. The mean age of the cases is between middle age group predicting young accidental or traumatic injuries leading to post burns. Similar results have been interpreted in various other literatures [20-23]. In the present study a comparative analysis within the fat graft and PRP technique was performed. The data collected presented that both of the techniques were giving reliable results. There was a

reduction in the wound size within the first 4 weeks and continued up to 12 weeks in both groups. There are four different phases of wound healing which includes hemostasis; inflammation; proliferation; and remodelling [24]. The literature supports that fat graft as well as PRP have presented data where wound healing has been observed in cases with post burns [20-24]. In context of scar quality as well as healing time and rate although both of the techniques were giving efficient performance, however the present study as well as research elsewhere have highlighted the fact that fat graft is more efficient in its performance and reduction of healing time with high healing rate. These results assisted in inkling the application of fat graft for the post burn scar treatments in cases especially with high thickness of wounds as was presented in the current study [23-25].

CONCLUSIONS

Application of platelet-rich plasma and fat graft both are efficient and reliable in reducing the scar quality and improving overall healing and reduction in burn scar. However, within the two groups the fat graft is more efficient and reliable with high healing time and rate.

Authors Contribution

Conceptualization: MN

Methodology: MA, HRA, MI, ALA

Formal analysis: MA, SF

Writing, review and editing: SI, HRA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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